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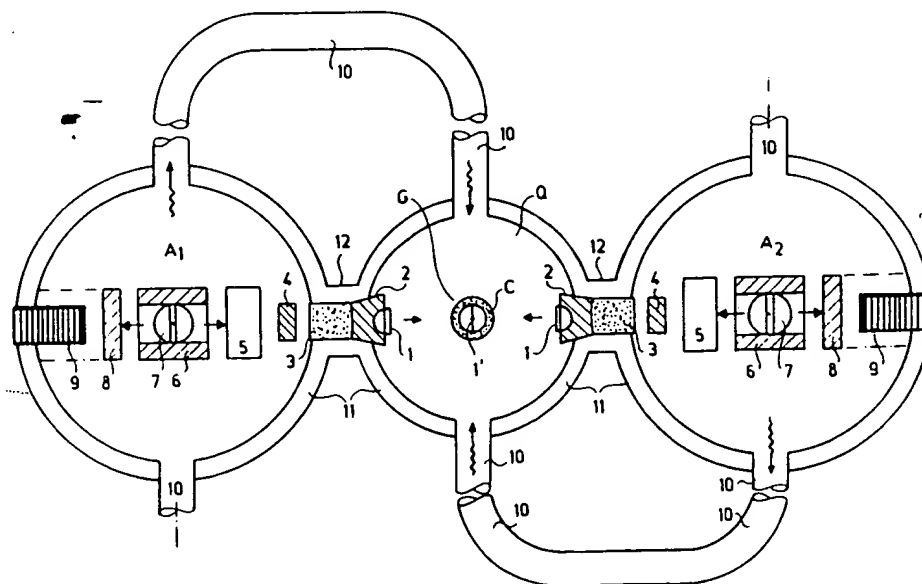
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(54) Title: ARRANGEMENT FOR CARRYING OUT INVESTIGATIONS OF ENERGETIC PROCESSES ON THE LEVEL OF ELEMENTARY PARTICLES AND FOR INVESTIGATING SUBSTRUCTURE OF THE MATERIAL



(57) Abstract

The invention refers to an arrangement for carrying out scientific investigations of energetic processes on the level of elementary particles and for investigating substructure of the material, comprising means for accelerating material parts constituting targets (2) in order to arrange their collision, wherein the accelerating means are formed by fission elements (7) placed on a common line with the targets (1) lying in equal distance from a middle point, the fission elements (7) acting by their nuclear reaction on the targets (1) causing their movement with substantially equal speed to the middle point.

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ARRANGEMENT FOR CARRYING OUT INVESTIGATIONS OF  
ENERGETIC PROCESSES ON THE LEVEL OF ELEMENTARY  
PARTICLES AND FOR INVESTIGATING SUBSTRUCTURE  
OF THE MATERIAL

FIELD OF INVENTION

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The present invention refers to an arrangement for carrying out investigations of energetic processes on the level of elementary particles and for investigating substructure of the material, comprising means for accelerating material parts constituting targets in order to arrange their collision.

BACKGROUND OF THE INVENTION

The production of superheavy elements having atomic number exceeding 120 is a very important task forwarding the development of the science and opening new perspectives in methods of producing energy.

The production of heavy elements is based in the scientific laboratories on accelerating material fragments comprising preselected appropriate elements. The beams carrying the nuclei of the elements accelerated are taken in collision and the high-energy nuclei melt together, they may constitute in this way the nucleus of a new element. The investigations have proved the advantage of applying different and similar elements, too. The problem of the known methods and arrangements lies in the fact that they can apply only small material fragments and the collision of these small fragments can result only in small amounts of the new elements to be produced. The small fragments can not be applied in many cases for inves-

investigating the energetic processes taking place on the subatomic level because of the energy limits introduced by the inherent features of the accelerators.

Another important field of the scientific investigations of the material on atomic and subatomic level is the generation of different kinds of radiation which reflects the inner atomic and subatomic structure. The methods of producing mesons and other elementary particles are therefore of utmost importance in looking for new kinds of processes which can be the basis of producing energy.

#### SUMMARY OF THE INVENTION

The invention is based on the recognition that the methods forming the basis of applying the ion accelerators can be used for producing new, superheavy elements only with limitations. The element to be produced can be characterized by atomic number at most 120 and mass number at most 480. This can be done also by colliding two uranium atoms. The present invention offers the possibility of applying the collision of two similar atoms (process denoted by AA). When making use of the collision of two different atoms, the process will be denoted by AB. The elements are appropriate which fulfil the condition that the sum of the two mass numbers is 431 and the sum of the atomic numbers is 169. This can be done e.g. by the collision of U 238 and Ir 193 or of Ra 226 and Tl 205 (the respective atomic numbers are: 92 for U, 77 for Ir, 88 for Ra and 81 for Tl). In the colliding beams the probability of processes of AA type is also relatively high because in the beams there are always more elements of the same kind present which can take part also in the collision.

From the processes having equilibrium state at mass number 480 and atomic number 120 can be expected that the nucleus is capable of being transformed into quark plasma state. This state cannot be stabilized, however, because the required pressure

and temperature conditions are possible to maintain only temporarily.

In the states below the equilibrium (e.g. the mentioned processes of uranium and iridium further radium and thallium) the quark plasma state cannot be follow. Furthermore, in the states produced e.g. by an uranium-collision the nucleus thus produced decays very quickly.

The invention is based on the recognition that in the nuclear radioactive processes the energy deliberated is generated by the kinetics of the collision. The kinetic energy can be sufficient for causing the collision of the elements in the target with composition AB in a way that the mass values AB in the reaction are with magnitudes higher than in the ion accelerators. The kinetic energy can be produced by nuclear explosion making use of small loads. This explosion should fulfill some conditions. The energy deliberated in the explosion must not cause scattering of the elements of the target (consisted of uranium and iridium or radium and thallium), but the heat energy of the explosion can help in the collision processes. A further recognition is that it is advantageous to accelerate simultaneously two targets and this requires practically the nuclear explosions initiated in the same moment in two places for carrying out the acceleration. The double explosion results in a high speed of the ions before the collision and the targets meet in their middle point. It is desired to give high strength the target therefore the elements constituting them are advantageously present in a common alloy or in a body made by sintering. They obviously can include some other components, especially of that kind which improve the strength parameters of the targets.

Hence, the present invention refers to an arrangement for carrying out investigations of energetic processes on the level of elementary particles and for investigating substructure of the material, comprising means for accelerating material parts constituting targets in order to arrange their

collision, and the essence of the invention lies in the solution that the accelerating means are formed by fission elements arranged on two sides of the targets on a common symmetry axis. the fission elements causing accelerating the material parts by a nuclear process initialized between them.

In an advantageous embodiment of the arrangement proposed by the invention the fission elements are arranged in closed spaces communicating with a chamber receiving the targets.

In another advantageous embodiment of the arrangement proposed by the invention the chamber is separated from the closed spaces by respective connecting tubes receiving from the side of the closed spaces fusion mixtures for accelerating the targets.

In another preferred embodiment of the arrangement realized according to the invention in the closed spaces at their outer end X-ray lasers are arranged, separated from the fission elements by shields, wherein the fission elements are arranged in tubes made of steel or tungsten and between the tubes and the fusion mixtures shield elements for neutron shielding are introduced.

If the conditions of the high accuracy collision of the targets can be done then it is preferred when in the middle point of the chamber an auxiliary target consisted of plutonium is arranged.

In the three space embodiment of the arrangement defined above according to the invention it is preferred when the fusion mixtures are separated from the targets by respective vessels made of tungsten alloyed, if necessary with samarium, the vessels advantageously being covered by a beryllium layer on their outer surface matching the connecting tubes and prepared for receiving the targets before their collision caused by nuclear processes.

In a further advantageous embodiment of the arrangement built-up according to the present invention the construction

can be relatively simply applied for meson radiation investigations when the fission elements and the fusion mixtures are arranged in a common space comprising the chamber in the middle part wherein the fusion mixtures are completed by copper and  
5 placed in a tube made of tungsten or steel, separated from the fission elements arranged in respective tubes made of tungsten or steel by containers including neutron absorbing substance, especially water or paraffin and boron.

In a yet further advantageous embodiment of the arrangement built-up according to the features of the present invention the construction can be relatively simply applied for pion  
10 radiation investigations when the fission elements are arranged together with X-ray lasers in a common space comprising the chamber in the middle part, wherein the fission elements and  
15 the X-ray lasers are placed within respective tubes made of tungsten or steel and the fission elements are separated from the tube containing the X-ray lasers by respective containers including neutron absorbing substance, especially water or paraffin and boron.

A yet another very advantageous realization of the arrangement proposed by the invention very intensive meson and especially pion radiation can be generated when the fission elements are arranged in closed spaces preferably of ellipsoid shape communicating with a chamber filled out with a fusion  
20 mixture. at the outer surface, the closed spaces forming Teller-Ulam-mirrors, the fusion mixture protrudes into tube parts connecting the chamber with the closed spaces wherein the fusion mixture defines an inner space filled out in cylindric arrangement with an outer mantle made of material of high  
25 hydrogen content, particularly PTFE or polyethylene, a pipe element made of copper, a plutonium layer and a low critical mass fission element, preferably forming a wire made advantageously of californium, wherein the plutonium layer is separated from the pipe element and from the fission wire  
30 element by respective layers made of gold. It is proposed to  
35



prepare the arrangement of the invention in the way that the closed spaces together with the chamber are arranged along a longitudinal axis of symmetry, wherein the fission elements and the targets lie on the axis of symmetry.

5 The most preferred choice of the materials applied in the arrangement of the invention is the following: the targets consist of at least one mixture comprising uranium and iridium or thallium and gold and the fusion mixtures comprise two lithium isotopes Li 6 and Li 7 and deuterium and tritium (i.e. H 2 and H 3).

10 The X-ray lasers are advantageously realized on the basis of tungsten plates covered from one side by boron and copper and from the other side by molybdenum and copper, wherein the space between the plates is filled out with PTFE or polyethylene.

15 The arrangements proposed by the present invention can be created by the means of known solutions and they offer the possibility of carrying out scientific investigations on the basis of material fragments having mass remarkably exceeding the mass of the targets applicable in the accelerators applied for such investigations.

#### BRIEF DESCRIPTION OF THE DRAWINGS

25 The invention will be further described in more detail with reference to some advantageous embodiments and realizations. In this description reference will be made to the attached drawings showing a schematic cross-section of the arrangement to be applied. In the drawings

30 **FIG. 1** shows the schematic cross-section of an arrangement to be applied for producing super heavy elements by causing heavy metallic particles collide,

**FIG. 2** shows the schematic cross-section of an arrangement to be applied for investigating X-ray radiation generated by accelerated material fragments,

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laminated bodies. The outer walls 11 are connected with light conductors 10 arranged perpendicularly to the line connecting the fission elements 7. Between the chamber Q and spaces  $A_1$  and  $A_2$  connecting tubes 12 are built-in. The targets 1 are arranged in respective vessels 2 made of tungsten, samarium and covered if necessary by beryllium. The fusion mixtures 3 are separated from the containers 5 by shield elements 4 made of boron and samarium. In some cases it is advantageous to apply in a central space G of the closed space Q an auxiliary target 1', as it will be described below in more detail.

As it is shown in Fig. 2, a relatively simple arrangement can be created for investigating the X-ray radiation generated by accelerated material fragments as fission products in a chamber Q determined by an outer wall 11 made of steel or other high strength material. In the chamber Q spaces  $A_1$  and  $A_2$  can be defined for receiving two nuclear fission elements 7 arranged along a longitudinal symmetry axis and the fission elements 7 lie in the interior of tube elements 6 acting as collimator and made of tungsten or steel. Between the fission elements 7 along the symmetry axis defined by them two containers 5 are applied which include water or paraffin and boron ( $^{10}\text{B}$ ). The containers 5 lie at two openings of a further tube element 6 including two X-ray laser means 9 radiating in opposite directions. The laser 9 is made of a material system including plates and high hydrogen content plastic therebetween, wherein the plates consist of tungsten ( $^{183}\text{W}$ ) covered from one side by boron and copper, and by molybdenum and copper on the other side.

A similarly simple arrangement can be realized according to Fig. 3 which is intended to be used in carrying out meson radiation investigations. In this arrangement instead of X-ray lasers 9 of Fig. 2 in the middle part of the chamber Q a fusion member is arranged which consists of a two fusion mixtures 7 comprising two lithium isotopes ( $\text{Li } 6$  and  $\text{Li } 7$ ) and two hydrogen isotopes ( $\text{H } 2$ , i.e. deuterium and  $\text{H } 3$ , i.e. tritium) and

copper. The fusion mixtures 3 are arranged at the two openings of a tube element 6 and limits a central space G with a middle point being the place of collision and covering the centre of gravity of the fusion mixtures 3.

5 In the arrangement illustrated in Fig. 4 and Fig. 5 the pion radiation can be investigated. This arrangement is also, as that of Fig. 1 is divided into three parts, i.e. a chamber Q being the middle part of the arrangement and two closed spaces denoted by  $A_1$  and  $A_2$ . The chamber Q limited from two sides by  
 10 the closed spaces  $A_1$  and  $A_2$  is shown in cross-section A-A in Fig. 5. The closed spaces denoted by  $A_1$  and  $A_2$  advantageously constitute ellipsoid shaped bodies comprising in one focus point respective fission elements 7 arranged on an axis being the symmetry axis of the middle part and separated from the  
 15 middle part by screening elements 4 made of boron and samarium. The middle part, i.e. the chamber Q is limited from two side and is surrounded by a fusion element 3 consisted of two lithium isotopes (Li 6 and Li 7) and two hydrogen isotopes (H 2, i.e. deuterium and H 3, i.e. tritium). The fusion element  
 20 3 constitutes an axialsymmetric body defining a central part which is limited from two sides on the symmetry axis by two screening elements 4 made of boron and samarium. Within the fusion element 3 there is a cylindric inner body D limited in axial direction by further two screening elements 4 made of  
 25 boron and samarium and in radial direction with an inner mantle 13 made of polyethylene and/or PTFE (e.g. teflon). The mantle 13 surrounds (Fig. 5) a pipe element 14 made of copper which comprises a material system including a small critical mass fission body prepared advantageously in the form of a californium wire 16 arranged along the symmetry axis and being covered  
 30 by a plutonium layer 15 separated by respective layers 17 and 18 made of gold from the californium wire 16 and from the copper pipe element 14. The fusion element 3 preferably has protrusions 3' limited by a spherical surface in the closed  
 35 spaces  $A_1$  and  $A_2$ , wherein the centre of the spherical surface

lie in the other focus point of the closed spaces  $A_1$  and  $A_2$  forming thereby Teller—Ulam-mirrors.

In the arrangement built-up according to Fig. 1 the targets 1 are consisted of at least one mixture made respectively of uranium and iridium or radium and thallium or gold and thorium (U 238, Ir 193; Th 232, Au 197). Of course, this is not the complete list, other appropriate elements (metals) can be applied, too. The targets 1 are hemispheres or other symmetric bodies forming together a sphere. The nuclear reaction caused by the X-ray lasers 9 in the fission elements 7 initiates a fusion reaction in the fusion mixtures 3 and the fusion reaction results in accelerating the targets 1. In this way about 80 % of the energy of the nuclear reactions may be usefully applied for generating kinetic energy. The accelerated targets 1 represent high mass, i.e. in the contrary to the ion accelerators the arrangement of the invention is capable of making relatively big material fragments react one with another. The arrangement of the invention works on the basis of a simultaneous nuclear reaction resulting in a meeting of the targets 1 in the middle part (central space G) of the chamber Q and in forming thereby a united charge C. Of course, the high strength of the targets 1 is required. In this arrangement the radiation can be kept within the closed spaces  $A_1$ ,  $A_2$  and the chamber Q.

By the process realized in the arrangement of the invention it is possible to increase the kinetic energy of the targets 1 by the means of the shock waves, thermal radiation and gamma radiation of the nuclear reactions. The shock wave is capable of increasing the density of the united charge C and the thermal effects result in increased temperature which is also helpful in producing superheavy elements. If the shock wave and the thermal radiation can be generated in a correlated manner then a fusion charge 3 can be helpful in further increasing the energy acting on the targets 1. The fusion charge 3 can be made of a mixture including two isotopes of lithium

(Li 6 and Li 7), deuterium (H 2) and tritium (H 3) wherein the components are arranged in an absorbent medium in order to form a shell on the united charge C. The fusion charge is then initialized to burn out by nuclear charges and this ensures  
 5 that the united charge is exposed to the increasing action of energy waves acting in a time sequence in different moments. In this way it is supposed to ensure a very high energy density state of plasma consisted of quarks.

When preparing the fusion charges 3 the outer surface of  
 10 the vessels 2 is advantageously covered by a thin beryllium mirror (reflecting surface) generating neutrons necessary for the operation of the fusion charge 3. The neutrons are absorbed in the material of the vessels 2. The mentioned "package" of the targets 1 should be kept together up to the moment of the  
 15 required action and therefore it is necessary to apply a medium transmitting the shock waves which can be completed with at least one component capable of decelerating the neutrons. On this basis it is advantageous to arrange the containers 5 within the spaces denoted by  $A_1$  and  $A_2$ , the containers 5 comprising water, paraffin and boron. The package of the targets 1  
 20 may require protection against neutrons and this prefers the application of the special shield elements 4 made of boron, cadmium, samarium or other appropriate materials. Another possibility is to prepare the shield elements 4 from more metallic  
 25 layers arranged perpendicularly to the direction of the radiation acting in the system.

Because of the explosive processes the arrangements consisting of the fission element 7 arranged within the tube 6, the container 5, the shield element 4, the fusion charge 3,  
 30 the vessel 2 and the target 1 (in the order listed up and in a reverse order, when looking from the middle part of the chamber Q) have high impulse therefore balancing means are necessary. These means consist of two part, the shield 8 and the X-ray laser or high energy X-ray generator 9 consisting of parallel  
 35 tungsten plates lying perpendicular to the longitudinal axis of

the arrangements listed up. The tungsten plate are completed by copper and boron from one side and by molybdenum and copper from the other side, the mentioned metals forming e.g. alloyed outer layers of a thicker tungsten plate. The different kinds of radiation and the particles impacting on the surface of the tungsten plates cause emission of very high intensity X-ray radiation leaving the system in the direction of the axis, i.e. of the targets 1. Thus, the X-ray radiation has an auxiliary effect resulting in increasing ionization of the targets 1 which should be in movement in the moment of generating this radiation.

The boron layer of the tungsten plates should be arranged on their side directed to the fusion charge because the boron layer has to transform neutrons into alpha-particles. The molybdenum layer should cover the other side of the tungsten plates. The molybdenum layer or the alloyed surface layer of tungsten comprising molybdenum is intended to increase the heat capacitance of the tungsten plate (it should be noted that the vessel 2 can be made also of a material comprising less or more molybdenum). On both sides of the tungsten plate it is advantageous to prepare a covering layer consisted of copper offering the advantage of being excited prior to molybdenum. In this way the copper ensures X-ray radiation exciting also the particles of molybdenum. Between the tungsten plates there are always free spaces - they should be filled with polyethylene or PTFE (teflon). The tungsten plates of the X-ray laser 9 or X-ray generator ensure relatively low auxiliary energy but in appropriate moments the small energy parts can be also very important for increasing the energy of the targets 1.

The fusion element 7 is arranged in a tube 6 made of tungsten in order to direct to the target 1 as much energy and as many particles and material fragments as possible.

The energy propagation conditions can be influenced in an advantageous manner when the fusion elements 7 are arranged in the middle part of spherical shaped spaces  $A_1$  and  $A_2$ , the

targets 1 meet one another also in the central point of a spherical space Q. A further step for stabilizing the united charge C in the central point of the space Q can be proposed, too: at least a part of the energy resulting from the fusion elements 7 in form of light and thermal radiation can be transmitted to the space Q by the means of the light conductors 10. The light conductors are constituted by pipelines connecting the spaces denoted by  $A_1$  and  $A_2$  with the central space Q. The light and thermal energy can be also helpful in stabilizing the united charge C and improving its energy balance.

The explosion processes in the spaces  $A_1$  and  $A_2$  result in a high speed movement of the targets 1 and in remarkable increase of their density. This is to be taken into account when computing the critical mass of the fusion processes. There is no problem when applying the uranium and iridium and/or the radium and thallium or gold and thorium mixtures, the first of them including if necessary thorium and gold. The mixtures can constitute alloys of the mentioned components. In the case of the transuranium elements the meeting of the parts of the targets 1 in the manner shown above can not be arranged. Hence, it is proposed to place and fix in the central space G of the closed space Q a further auxiliary target 1' consisted of e.g. plutonium in a form that it will constitute together with the targets 1 on their impacting a sphere. This solution makes it necessary to arrange the collision of the targets in the moment when their centre of gravity lies in the middle point of the space Q with accuracy  $\pm 0.1$  mm. If the mentioned mixtures are applied the auxiliary target 1' is not required and the accuracy can be also lower: the centre of gravity of the targets 1 may be kept in a distance up to 10 mm from the middle point of the space Q.

The arrangement shown in Fig. 1 is proposed especially for carrying out scientific investigations directed to the problems of generating and producing superheavy elements. The targets 1 consisted of mixtures (alloys) made of uranium and

iridium and/or of radium and thallium, the arrangement illustrated in Fig. 1 can be realized without technical problems and other target compositions can be applied, too, e.g. uranium and copper. The arrangement of Fig. 1 built-up according to the invention offers the advantage that in comparison to the known and presently applied accelerating means the masses taken into collision can be very high and it can be realized with lower costs than the accelerators.

The arrangement proposed by the present invention can be constructed in the form of the less sophisticated embodiment shown in Fig. 2. In this case the collision of appropriate parts of two fission charges 7 arranged in respective tube elements 6 made of steel or tungsten on two sides of a bidirectionally radiating X-ray laser means 9 is generated. The X-ray laser means 9 are realized in a similar manner as shown in and described in connection with Fig. 1 by tungsten plates covered from one side by boron and copper and from the other side by molybdenum and copper. The containers 5 separate the tube elements 6 receiving the fission elements 7 from the tube element 6 of the X-ray laser means 9. The high intensity X-ray radiation generated by the X-ray laser means 9 results in accelerating of different material fragments which by their collision produce high intensity X-ray radiation. The radiation has to be detected in order to investigate the energetic processes on the subatomic level, the processes having place between the elementary particles.

The simple arrangement of the present invention shown in Fig. 3 is intended to make use of atomic processes to carry out investigations of meson radiation, and especially of the pion radiation.

The high energy protons of energy exceeding about 310 MeV are generated in the fission elements 7 and act on targets constituted by fusion charges 3 consisted of copper and the usual isotopes applied in the fusion processes (Li 6 and Li 7 together with the deuterium and tritium, H 2 and H 3). The



target can be made of other elements of low atomic number, e.g. of beryllium or pure copper). The energy limit about 310 MeV is required for generating elementary particles. The presence of the hydrogen in the targets is highly preferred because by  
 5 applying charged pions in the hydrogen neutral pions can be generated. The neutral pions show gamma-decay of energy 70 MeV and 131 MeV.

The intensity of the gamma radiation originated from the decay of the neutral pions can be as many as hundred times  
 10 higher than the intensity of the other processes. This energy is capable of causing nuclear reactions, e. g. the decay of oxygen atoms to alpha particles. The protons can be produced from compositions comprising hydrogen. The sufficient amount of hydrogen can be comprised in chemical charges or in composi-  
 15 tions forming the targets. The targets 1 bombarded by protons advantageously consist of Li 9, F 9, Sc 21, Cu 29 (lithium, fluor, scandium and copper). The parts made of beryllium have to constitute sources of positively and negatively charged pions. In the arrangement of Fig. 1 respective beryllium layers  
 20 are preferably applied on the vessels 2 and therefore here and in lithium bombarded by protons pions are generated. The targets comprising hydrogen are very important because the hydrogen constitute always the source of protons and the atoms as targets of negative pions generate neutral pions issuing gamma  
 25 radiation.

In the arrangement shown in Fig. 3 the fusion mixtures 3 united by a collision process can be completed by copper. The negative pions producing also negative mions by their decay show catalytic effect because they make nuclear reactions pos-  
 30 sible at relatively low energy. They can improve the energy balance of the energetic reactions.

The arrangement shown in Fig. 4 and Fig. 5 is surrounded by outer walls 11 of high mechanical strength which forms a pipe type element. With the inner surface of this pipe is a  
 35 fusion mixture 3 kept in touch which is covered from both sides

by respective beryllium layers. In the central axis of this pipe shaped fusion mixture 3 the fission element is arranged: this is light body of critical mass being as small as possible. Therefore the californium wire 16 is preferred which is surrounded by a plutonium layer 15 covered from inside and outside by the gold layers 17 and 18. The outer gold layer 18 contacts a copper mantle 14 acting as pion source, the pions influencing the processes taking place in the californium wire 16. The space between the fission wire 16 and the fusion mixture 3 is filled out with polyethylene and/or PTFE (teflon) forming an inner mantle 13 comprising hydrogen in order to ensure protons bombarding copper. The filling is capable of fixing the fission wire. Teflon is of advantage that it comprises fluor which can take part in generating the negative pions.

The filling made of material of high hydrogen content should preferably be solid, however, the gaseous and eventually the liquid compositions may be applied if required. The solid filling has the advantage that it can be equipped with a beryllium layer on inner and/or outer side in the case of any material. The arrangement of Figure 4 should be initiated in a traditional manner. The fusion mixture 3 generates during its fusion reaction negative pions which enter the material of the fission element, i.e. the californium wire 16. In this way a chain reaction can be initialized. When applying PTFE (teflon) the fluor present therein constitutes also a source of negative pions which colliding with the nuclei of the hydrogen atoms generate neutral pions. In this way very intensive X-ray radiation comes into being and the direction where this radiation propagates lies oppositely to the direction of propagating the reaction in the fusion mixture.

The arrangement shown in Fig. 4 can be applied also in a multiplicated system comprising more than one of this arrangements. The tube shaped outer walls 11 should be in this case of equal length.

The different embodiments of the arrangement proposed by

the present invention offers the relatively low cost possibility of carrying out investigations in material systems, producing new elements and seeking for new kinds of energy producing reactions.

## WHAT I CLAIM IS:

5  
 1. An arrangement for carrying out investigations of energetic processes on the level of elementary particles and for investigating substructure of the material, comprising means for accelerating material parts constituting targets in  
 10 order to arrange their collision, **characterized in that** the accelerating means are formed by fission elements (7) placed on a common line with the targets (1) lying in equal distance from a middle point, the fission elements (7) acting by their nuclear reaction on the targets (1) causing their movement with  
 15 substantially equal speed to the middle point.

2. The arrangement as set forth in claim 1, **characterized in that** the fission elements (7) are arranged in closed spaces ( $A_1$ ,  $A_2$ ) communicating with a chamber (Q) receiving the targets (1) and the middle point, the closed spaces  
 20 ( $A_1$ ,  $A_2$ ) and the chamber (Q) forming a system having two symmetry axis, one of them crossing the middle point.

3. The arrangement as set forth in claim 2, **characterized in that** the chamber (Q) is separated from the closed spaces ( $A_1$ ,  $A_2$ ) by respective connecting tubes (12) receiving  
 25 from the side of the closed spaces ( $A_1$ ,  $A_2$ ) fusion mixtures (3) for accelerating the targets (1), wherein the targets (1) are arranged in the outlets of the connecting tubes (12) on the side of the chamber (Q).

4. The arrangement as set forth in claim 3, **characterized in that** in the closed spaces ( $A_1$ ,  $A_2$ ) at their outer  
 30 end X-ray lasers (9) are arranged, separated from the fission elements (7) by shields (8), wherein the fission elements (7) are arranged in tubes (6) made of steel or tungsten and between the tubes (6) and the fusion mixtures (3) shield elements (4)  
 35 for neutron shielding are introduced.

5. The arrangement as set forth in any of claims 1 to 4, **characterized in that** in the central space (G) of the chamber (Q) receiving the middle point an auxiliary target (11) consisted of plutonium is arranged.

6. The arrangement as set forth in any of claims 3 to 5, **characterized in that** the fusion mixtures (3) are separated from the targets (1) by respective vessels (2) made substantially of tungsten, the vessels (2) being arranged in the connecting tubes (12).

7. The arrangement as set forth in claim 6, **characterized in that** the vessels are made of tungsten alloyed with samarium.

8. The arrangement as set forth in claim 6 or 7, **characterized in that** the vessels (2) are covered by a beryllium layer on their outer surface matching the connecting tubes (12).

9. The arrangement as set forth in claim 1, **characterized in that** the fission elements (7) and the fusion mixtures (3) are arranged in a common space comprising a chamber (Q) in the middle part for receiving the targets (1) wherein the fusion mixtures (3) are completed by copper and placed in a tube (6) made of tungsten or steel, separated from the fission elements (7) arranged in respective tube elements (6) by containers (5) including neutron absorbing substance, the tube elements (6) made of tungsten or steel.

10. The arrangement as set forth in claim 9, **characterized in that** the containers (5) include as neutron absorbing substance water or paraffin and boron.

11. The arrangement as set forth in claim 1, **characterized in that** the fission elements (7) are arranged together with X-ray lasers (9) in a common space comprising the chamber (Q) in the middle part, wherein the fission elements (7) and the X-ray lasers (9) are placed within respective tube elements (6) made of tungsten or steel and the fission elements (7) are separated from the tube elements (6) containing the X-

-ray lasers (9) or high intensity X-ray generator by respective containers (5) including neutron absorbing substance.

12. The arrangement as set forth in claim 11, **characterized in that** the containers (5) include as neutron absorbing substance water or paraffin and boron.

13. The arrangement as set forth in claim 1, **characterized in that** the fission elements (7) are arranged in closed spaces ( $A_1$ ,  $A_2$ ) communicating with a chamber (Q) filled out with fusion mixture (3) at the outer surface, the fusion mixture (3) protrudes through respective tube parts (12) into the closed space ( $A_1$ ,  $A_2$ ) and connecting by their protrusions (3') the chamber (Q) with the closed spaces ( $A_1$ ,  $A_2$ ) wherein the fusion mixture (3) defines and surrounds an inner space filled out with a cylindric inner body (D) arranged with an outer mantle (13) made of a material of high hydrogen content, particularly PTFE or polyethylene, a pipe element (14) made of copper, a plutonium layer (15) and a low critical mass fission wire (16), wherein the plutonium layer (15) is separated from the pipe element (14) and from the fission wire (16) by respective layers (17, 18) made of gold.

14. The arrangement as set forth in claim 13, **characterized in that** the low critical mass fission wire (16) is made of californium.

15. The arrangement as set forth in any of claims 1 to 10, **characterized in that** the closed spaces ( $A_1$ ,  $A_2$ ) together with the chamber (Q) are arranged having a longitudinal axis of symmetry, wherein the fission elements (7) and the targets (1) lie on the axis of symmetry.

16. The arrangement as set forth in any of claims 13 to 15, **characterized in that** the closed spaces ( $A_1$ ,  $A_2$ ) are made in the shape of ellipsoid bodies, having the fission elements (7) and the protrusions (3') of the fusion mixture (3) in the focus points of the ellipsoids, the focus points lying on the longitudinal symmetry axis of the closed spaces ( $A_1$ ,  $A_2$ ) and the chamber (Q).

17. The arrangement as set forth in any of claims 13 to 16, **characterized in that** the fusion mixture (3) is limited on its surfaces matching the outer wall (11) and the inner mantle (13) by respective beryllium layers (19, 20).

5 18. The arrangement as set forth in any of claims 1 to 17, **characterized in that** the target (1) consists of a mixture comprising at least one pair of elements selected from the pairs consisted of uranium and iridium, thallium and radium, and thorium and gold and the fusion mixtures (3) comprise two  
10 lithium isotopes Li 6 and Li 7 and two hydrogen isotopes, i.e. deuterium and tritium.

15 19. The arrangement as set forth in any of claims 3 to 11, **characterized in that** the X-ray lasers (9) are built-up with tungsten plates covered from one side by boron and copper and from the other side by molybdenum and copper, wherein the space between the plates is filled out with PTFE or polyethylene.

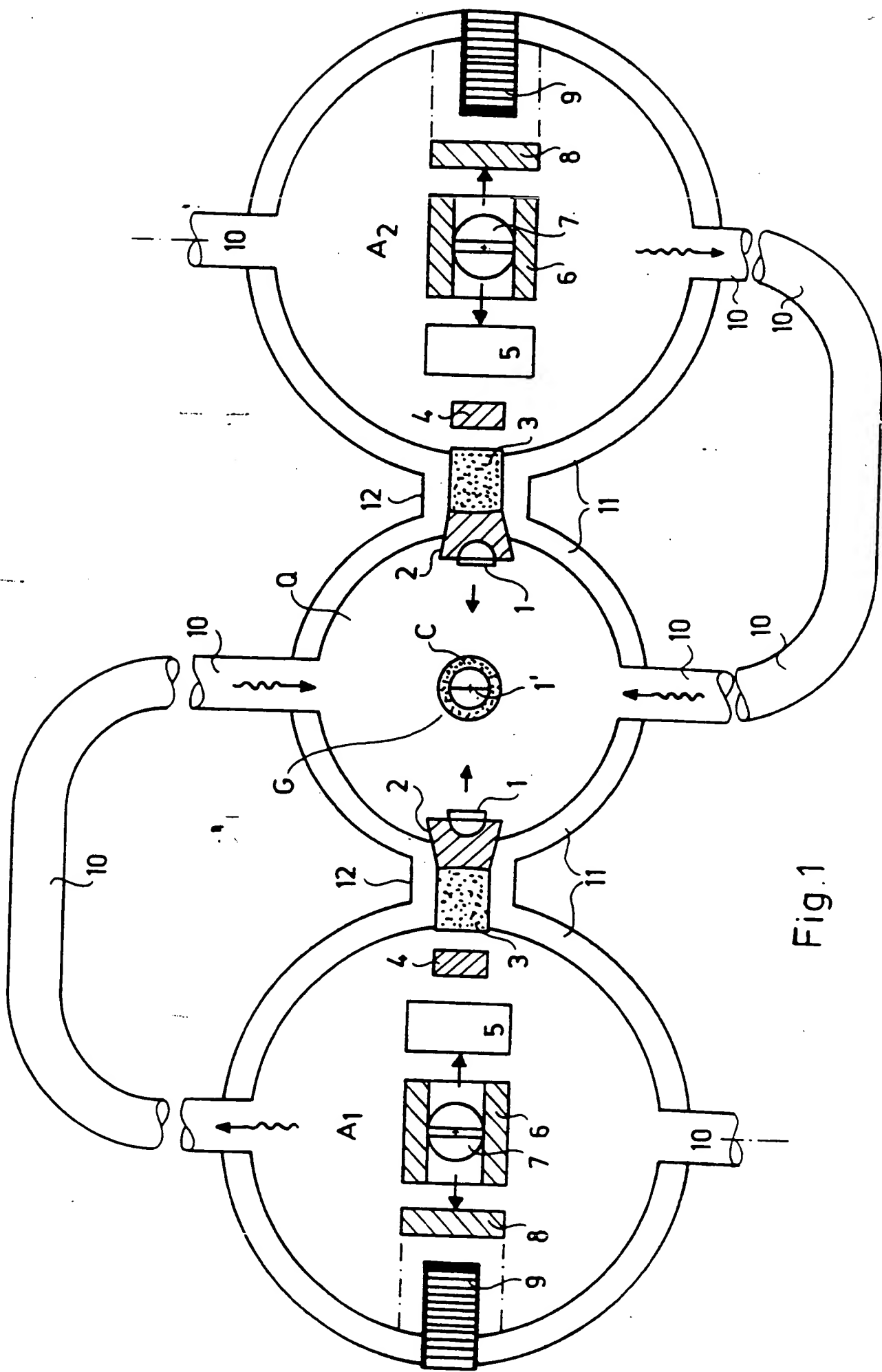


Fig.1



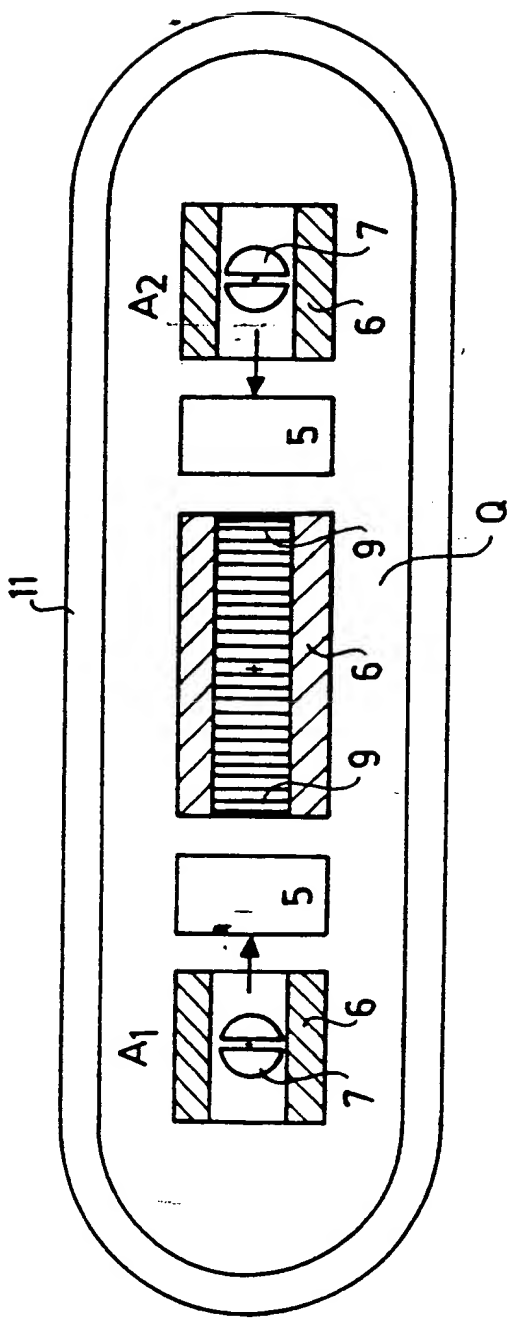


Fig. 2

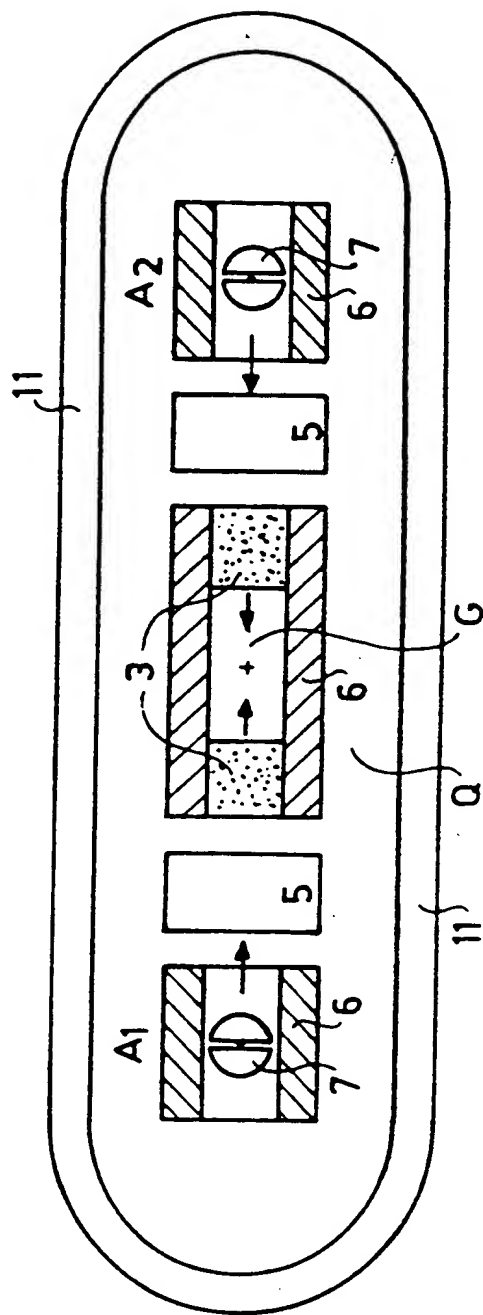


Fig. 3

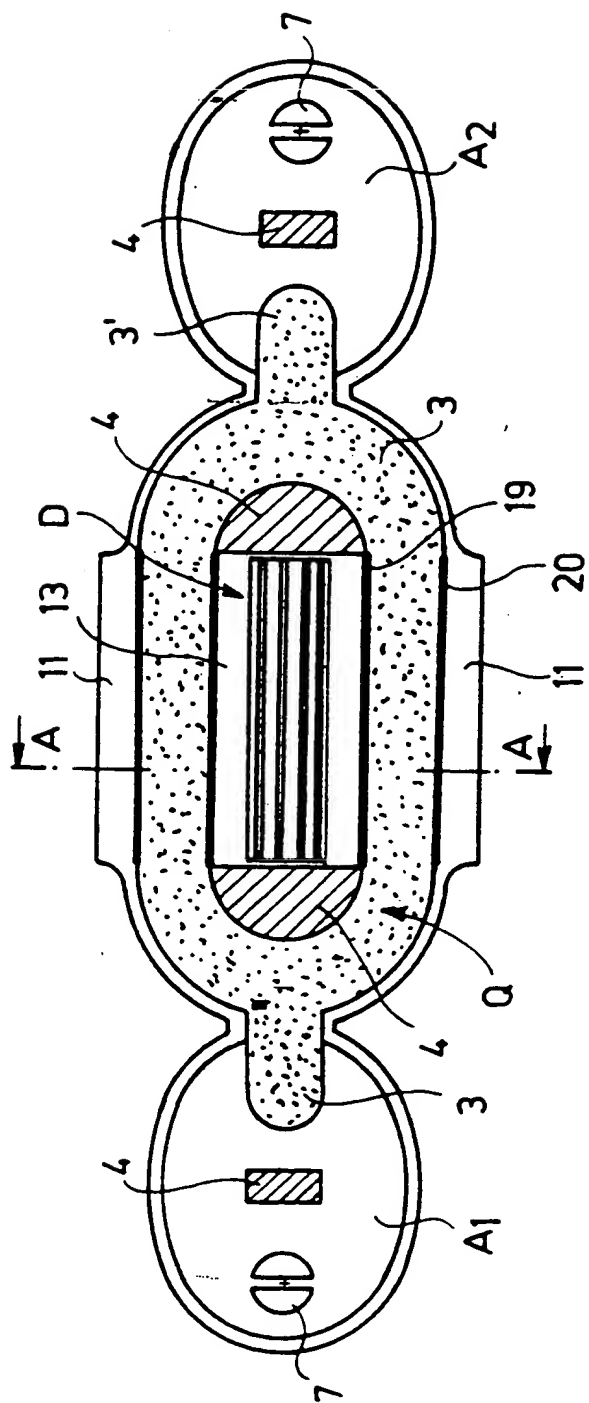


Fig. 4

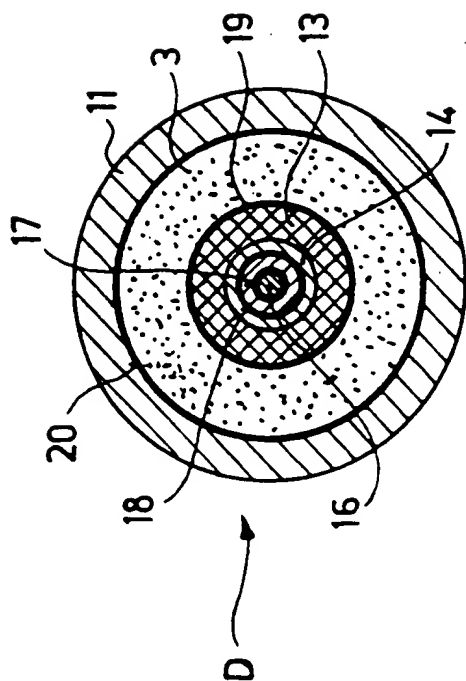


Fig. 5

**I. CLASSIFICATION SUBJECT MATTER** (If several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC<sup>5</sup>: G 21 G 1/04 // G 21 J 3/00**II. FIELDS SEARCHED**Minimum Documentation Searched <sup>7</sup>

| Classification System | Classification Symbols   |
|-----------------------|--|
| Int.Cl. <sup>5</sup>  | G 21 G 1/00, 1/04, 1/10; G 21 K 1/00, 1/08, 5/00-5/10;<br>H 05 H 3/00, 3/06, 5/00, 5/03, 5/06, 9/00, 15/00;<br>G 21 J 1/00, 3/00 |

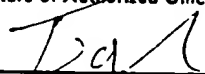
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| Category * | Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>                                   | Relevant to Claim No. <sup>13</sup> |
|------------|--|-------------------------------------|
| A          | DE, A, 2 056 199 (GENSWEIN) 25 May 1972 (25.05.72),<br>see fig. 12.  | (1-4, 6, 9, 11,<br>15, 16)          |
| A          | GB, A, 1 446 671 (WINTERBERG) 18 August 1976<br>(18.08.76), see page 1, lines 41-57; page 2, lines<br>15-31; page 3, lines 29-34, 43-48; claims. | (1-5, 9)                            |
| A          | FR, A, 1 350 078 (PEYRON) 22 April 1964 (22.04.64),<br>see fig. 1, 2.  | (1-3, 6, 9, 15,<br>16)              |
| A          | FR, A, 1 331 491 (SEPI) 06 November 1963 (06.11.63),<br>see fig.   | (1)                                 |
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**IV. CERTIFICATION**

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| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report                                  |
| 14 December 1990 (14.12.90)                               | 18 December 1990 (18.12.90)  |
| International Searching Authority                         | Signature of Authorized Officer  |
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No. PCT/HU 90/00031

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None

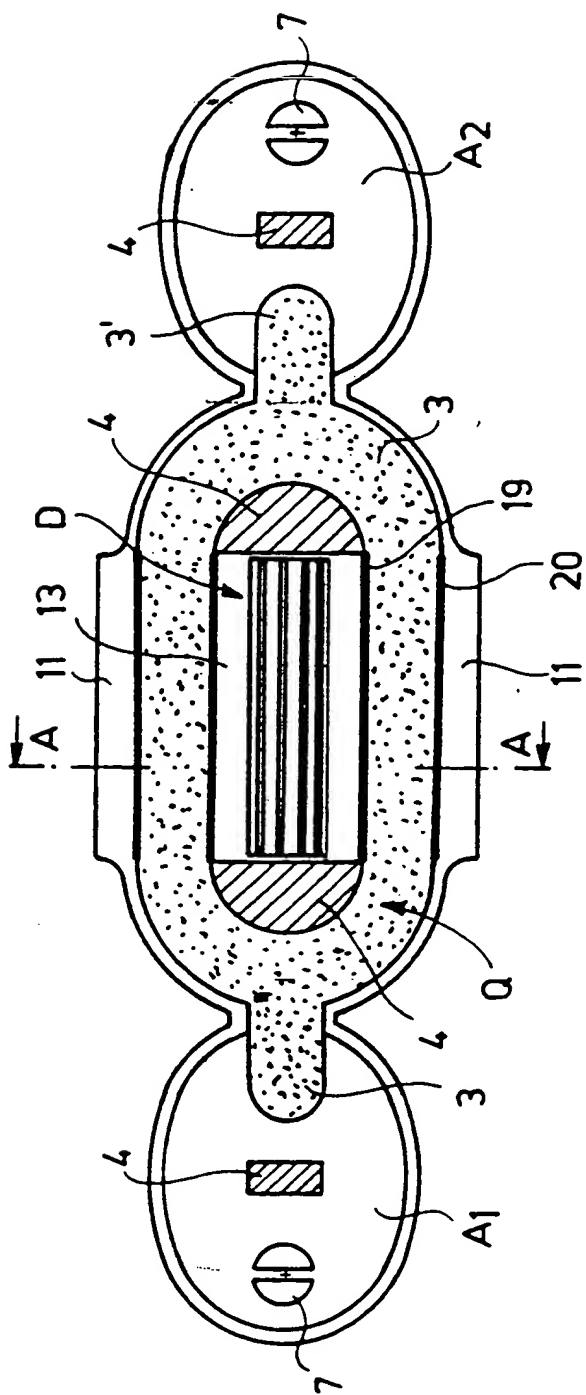


Fig. 4

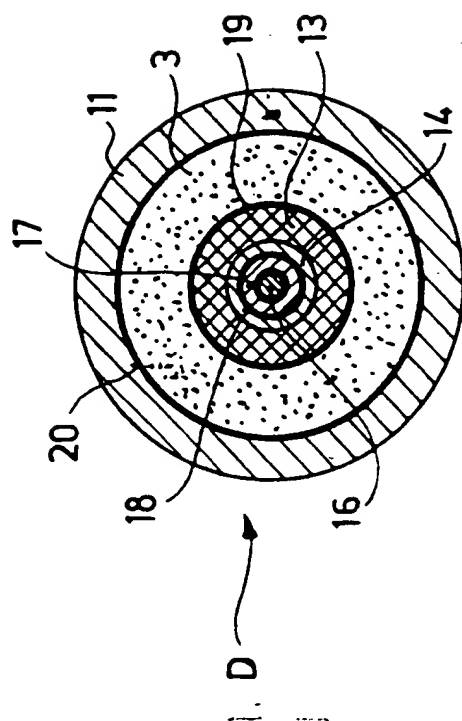


Fig. 5

**I. CLASSIFICATION SUBJECT MATTER** (If several classification symbols apply, indicate all) <sup>6</sup>

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IPC<sup>5</sup>: G 21 G 1/04 // G 21 J 3/00**II. FIELDS SEARCHED**Minimum Documentation Searched <sup>7</sup>

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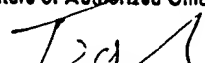
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FR-A - 1331491 None